

WHAT IS CLAIMED IS:

1. A plasma processing system comprising:
 - a plasma processing chamber;
 - a vacuum pump connected to the processing chamber;
 - a substrate support supporting a substrate within the processing chamber;
 - a dielectric member having an interior surface facing the substrate support, wherein the dielectric member forms a wall of the processing chamber;
 - a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including a plurality of gas outlets supplying process gas into the processing chamber; and
 - an RF energy source which inductively couples RF energy through the dielectric member and into the chamber to energize the process gas into a plasma state to process the substrate.
2. The system of Claim 1, wherein the system is a high density plasma chemical vapor deposition system or a high density plasma etching system.
3. The system of Claim 1, wherein the RF energy source comprises an RF antenna and the gas injector injects the process gas toward a primary plasma generation zone in the chamber.
4. The system of Claim 1, wherein the gas outlets are located in an axial end surface of the gas injector.

5. The system of Claim 1, wherein the gas outlets include a center gas outlet extending in an axial direction perpendicular to the exposed surface of the substrate and a plurality of angled gas outlets extending at an acute angle to the axial direction.
6. The system of Claim 1, wherein the gas injector injects the process gas at a subsonic, sonic, or supersonic velocity.
7. The system of Claim 1, wherein the gas injector includes a planar axial end face which is flush with the interior surface of the dielectric window.
8. The system of Claim 1, wherein the gas injector is removably mounted in the dielectric window and supplies the process gas into a central region of the chamber.
9. The system of Claim 1, wherein the gas injector includes a closed distal end and the gas outlets inject process gas at an acute angle relative to a plane parallel to an exposed surface of the substrate.
10. The system of Claim 1, wherein the gas injector is removably mounted in the opening in the dielectric window and includes at least one O-ring providing a vacuum seal between the gas injector and the dielectric window.
11. The system of Claim 1, wherein the RF energy source comprises an RF antenna in the form of a planar or non-planar spiral coil and the showerhead nozzle injects the process gas toward a primary plasma generation zone in the chamber.
12. A method of plasma processing a substrate comprising:

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placing a substrate on a substrate support in a processing chamber, wherein an interior surface of a dielectric member forming a wall of the processing chamber faces the substrate support;

supplying process gas into the processing chamber from a gas injector extending through the dielectric member such that a distal end of the gas injector is exposed within the processing chamber, the gas injector including a plurality of gas outlets supplying process gas into the processing chamber; and

energizing the process gas into a plasma state by inductively coupling RF energy produced by the RF energy source through the dielectric member into the processing chamber, the process gas being plasma phase/reacted with an exposed surface of the substrate.

13. The method of Claim 12, wherein the RF energy source comprises an RF antenna in the form of a planar or non-planar spiral coil and the gas injector injects the process gas toward a primary plasma generation zone in the chamber.

14. The method of Claim 12, wherein the gas outlets inject the process gas in a direction other than directly towards the exposed surface of the substrate.

15. The method of Claim 12, wherein the gas injector extends below an inner surface of the dielectric window and the gas outlets inject the process gas in a plurality of directions.

16. The method of Claim 12, wherein the gas injector injects the process gas at a subsonic, sonic, or supersonic velocity.

17. The method of Claim 12, wherein individual substrates are consecutively processed in the processing chamber by contacting the substrates with the plasma gas so as to deposit or etch a layer on each of the substrates.

18. The method of Claim 12, wherein the gas injector extends into a central portion of the chamber and the gas outlets inject the process gas in a zone between the exposed surface of the substrate and the interior surface of the dielectric member.

19. The method of Claim 12, wherein the gas outlets include a central gas outlet in the distal end of the gas injector and a plurality of gas outlets surrounding the central gas outlet, the gas outlets injecting the process gas in a plurality of different directions.

20. The method of Claim 12, comprising plasma etching an aluminum layer on the substrate by injecting a chlorine containing gas through the gas outlets, each of the gas outlets injecting the gas in a direction which is not perpendicular to the exposed surface of the substrate.

21. The method of Claim 12, comprising plasma etching a polysilicon layer on the substrate by injecting a chlorine and/or bromine containing gas through a central gas outlet in an axial direction which is perpendicular to the exposed surface of the substrate and through a plurality of angled gas outlets surrounding the central outlet, the angled gas outlets injecting the gas in directions oriented at an angle of 10 to 60° to the axial direction.

22. The method of Claim 12, comprising plasma etching a silicon oxide layer on the substrate by injecting a fluorine containing gas through a central gas outlet in an axial direction which is perpendicular to the exposed surface of the substrate and/or through a

plurality of angled gas outlets surrounding the central outlet, the angled gas outlets injecting the gas in directions oriented at an angle of 10 to 60° to the axial direction.

23. The method of Claim 12, comprising plasma etching a polysilicon layer on the substrate by injecting a chlorine and/or bromine containing gas through a central gas outlet in an axial direction which is perpendicular to the exposed surface of the substrate and through a plurality of angled gas outlets surrounding the central outlet, the angled gas outlets injecting the gas in directions oriented at an angle of 10 to 30° to the axial direction.

24. The method of Claim 12, comprising plasma etching a silicon oxide layer on the substrate by injecting a fluorine containing gas through a central gas outlet in an axial direction which is perpendicular to the exposed surface of the substrate and/or through a plurality of angled gas outlets surrounding the central outlet, the angled gas outlets injecting the gas in directions oriented at an angle of 10 to 45° to the axial direction.

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